



GOVERNMENT OF INDIA

MINISTRY OF TOURISM AND CIVIL AVIATION

(COMMISSION OF RAILWAY SAFETY)

RAILWAY ACCIDENT INVESTIGATION

REPORT

on

DERAILMENT

of

No. 28 Up West Coast Express Train

at

PATTAMBI STATION, SOUTHERN RAILWAY,

on

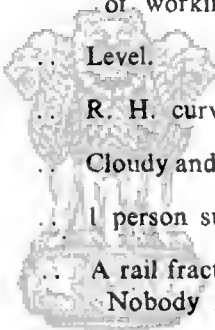
24TH AUGUST, 1970.

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SUMMARY

1. Date 24th August 1970.
2. Time 03-15 hours.
3. Railway Southern Railway.
4. Gauge 5'—6".
5. Location Pattambi station.
6. Nature of accident Derailment.
7. Train involved No. 28 Up "West Coast Express".
8. Consisting of 9 bogie coaches.
9. Engine No. WP 7153.
10. Estimated speed About 15 Km. p.h.
11. Number of tracks and method of working. .. Single Line Section with Absolute Block System of working.
12. Gradient Level.
13. Alignment R. H. curve of 2508 feet nominal radius.
14. Weather Cloudy and dark.
15. Casualties 1 person sustained a grievous injury.
16. Cause and party held responsible .. A rail fracturing under the running train.
Nobody held responsible.



सत्यमेव जयते

**GOVERNMENT OF INDIA,
MINISTRY OF TOURISM AND CIVIL AVIATION,
(COMMISSION OF RAILWAY SAFETY)**

FROM

THE ADDITIONAL COMMISSIONER OF RAILWAY SAFETY,
SOUTHERN CIRCLE,
BANGALORE.

TO

THE SECRETARY TO THE GOVERNMENT OF INDIA
MINISTRY OF TOURISM & CIVIL AVIATION,
NEW DELHI.

THROUGH : THE COMMISSIONER OF RAILWAY SAFETY, LUCKNOW.

Sir,

In accordance with Rule 10 of the Railway Board's Notification No. 59/TTV/42/1 dated the 11th April 1966 I have the honour to report the result of my Inquiry into the derailment of No. 28 Up "West Coast Express" train at Pattambi station on the Southern Railway on the morning of the 24th August 1970.

2. Inspection and Inquiry

The site of the accident was inspected by me on the morning of the 25th August in company with the Divisional Superintendent, Olavakkot and other Officers of the Southern Railway.

The Inquiry was held at Shoranur on the 25th and the 26th August, and concluded on the 27th August at Olavakkot, the Divisional Superintendent, Olavakkot Shri K. T. Raghavan being present at the same.

The Civil Authorities and the Police were informed of the Inquiry and were represented by Shri M. K. Vasudeva Menon, Inspector, Railway Police, Shoranur on the 25th August.

The injured passenger was visited in the Olavakkot Railway Hospital on the 27th August.

[Note—The terms "front", "rear", "leading", "trailing", "left", and "right", where used, are with reference to the direction of motion of No. 28 Up "Express".]

I. PREAMBLE

3. Brief Description of the Accident

No. 28 Up "West Coast Express" train derailed while it was passing through Pattambi station on the loop line at 03-15 hours on the 24th August 1970.

4. Casualties

As a result of the accident 1 lady passenger sustained a grievous injury.

5. Composition of the Train

No. 28 Up Express consisted of 9 bogie coaches hauled by a steam locomotive. The train was marshalled in the following order :—

Engine No. WP 7153;

1st Coach TLR No. 4774	..	Third Class, Luggage and Brakevan;
2nd Coach WGT No. 5244	..	Vestibuled Third Class;
3rd Coach GTCW No. 5328	..	Third Class Two Tier Sleeper;
4th Coach GST No. 4454	..	Second & Third Class;
5th Coach WFC No. 5898	..	Vestibuled First Class with Coupe Compartment;
6th Coach GTCG No. 5485	..	Third Class Three Tier Sleeper-cum-Sitting;
7th Coach GTCG No. 5456	..	Third Class Three Tier Sleeper-cum-Sitting;
8th Coach WFCT No. 1225	..	Vestibuled First Class with Coupe Compartment, and Third Class;
9th Coach TLR No. 4779	..	Third Class, Luggage and Brakevan.

The train was fully vacuum braked, and its length and weight were approximately 736 feet and 545 tonnes respectively (inclusive of the engine).

All the coaches had steel bodies.

The engine was fitted with a head light and a speed indicator-cum-recorder of the VDO type both of which were in working order at the time.

6. Damage and Disposition of the Vehicles

(i) The position of the train when it came to a stop was as detailed below :—

- (a) The engine and the 1st coach had successfully negotiated the Up Trailing Points and were intact on the main line.
- (b) The 2nd, 3rd and 4th coaches were also on the main line, but had sustained minor damage to their underframes, which indicated that they had derailed and rerailed themselves.
- (c) The 5th coach was on the rails on the lead portion of the Up Trailing Points. The undergear of this coach had sustained slightly more damage, and its right leading buffer had fallen off and was lying on the track to the rear near the 6th coach—more or less opposite Kilometre Post 590. The indications were that this coach had also derailed and rerailed itself.
- (d) All the wheels of the 6th coach had derailed except the trailing pair of the leading bogie. This coach had also sustained sundry damage to its undergear.
- (e) All the wheels of the 7th coach had derailed, and portions of its undergear were damaged.
- (f) Only the leading bogie of the 8th coach was in the derailed condition, and its undergear was slightly damaged.
- (g) The 9th coach was intact on the track and not damaged in any way.

(ii) The permanent way was damaged for a length of approximately 160 feet (plain track), and in particular, the right hand rail at the point of derailment was broken into 7 pieces.

The splice rail of the crossing of the Up Trailing Points was bent, and the distance block connecting the splice and point rails of this crossing was smashed. The corresponding check rail on the left was also bent, and there were indications of wheels having ridden over its check blocks.

(iii) There was no damage to the signalling or interlocking gear.

(iv) The total cost of damage has been approximately estimated as follows :—

Coaching stock	Rs. 2,000
Permanent Way	Rs. 2,000
Total	Rs. 4,000

7. Number of Passengers

The seating capacity of No. 28 Express was 566, and it was estimated that there were approximately 400 passengers in the train.

8. Weather Conditions

It was cloudy and dark at the time.

II. RELIEF MEASURES

9. First-aid and Medical Assistance

Information about the accident was relayed over the control phone at 03-20 hours. The Shoranur Medical Relief Van was straightway ordered out, and it left at 03-45 hours with the Assistant Medical Officer and the Assistant Engineer, Shoranur accompanied by other supervising subordinate staff.

Meanwhile, the Guard and the Travelling Ticket Examiners on the train made inquiries as to whether any of the passengers were injured, but nobody gave any indication as to having sustained any injury. When the Medical Relief Van arrived at the site at 04-45 hours with the Assistant Medical Officer, Shoranur, further inquiries were again made, but none of the passengers reported any injury.

The engine and the first 4 coaches left the site at 06-00 hours after having been certified fit by the Train Examiner, Shoranur—and arrived at 06-25 hours, at Shoranur, the Assistant Medical Officer returning in one of these coaches. On arrival, however, one of the lady passengers complained of pain in her left arm and chest, so she was taken to the Railway Hospital and attended to.

Meanwhile, the Divisional Superintendent, the Divisional Medical Officer and other Officers at Olavakkot, the Divisional Headquarters, had proceeded directly to the site by road. Finding that all the

passengers had gone to Shoranur, the Divisional Medical Officer then came on to Shoranur by road and, after further examining the lady passenger who had complained of pain took her with him by road to Olavakkot, where she was admitted into the Railway Hospital at 09-45 hours.

10. Restoration of Communications

The Break-down Special left Shoranur at 04-40 hours and arrived at the site at 06-45 hours. The 6th and 7th coaches were first rerailed and the main line restored for through running at 11-45 hours the first train to pass over the affected portion being No. 1 Down "Madras-Mangalore Mail" train at 13-16/18 hours.

The derailed 8th coach, which was not fouling the main line, was then rerailed at 12-25 hours.

The loop line was restored at 08-30 hours the next day.

III. LOCAL CONDITIONS

11. Description of the Site and Method of Working

(i) Pattambi is a 'B' Class station on the Shoranur-Mangalore section of the Southern Railway. The adjacent stations are Pallippuram (to the west) and Karakad (to the east), the line running more or less west-east from Pallippuram to Karakad through Pattambi.

Trains are worked on the Absolute Block System by means of Neale's Ball Token Instruments, trains from Pallippuram to Karakad through Pattambi being termed "Up" trains, and those from Karakad to Pallippuram through Pattambi "Down" trains.

The station has Standard I interlocking, and is equipped with the full complement of Multiple-Aspect Upper Quadrant Semaphore Signals (including Bracketted Homes, Starters, and Advanced Starters), the points and signals being operated from a cabin at either end—designated 'B' Cabin (to the west) and 'A' Cabin (to the east). There are 2 running lines—the main line and the loop line—and a goods shed siding takes off from the main line at the west end. The main line is served by a high level platform.

(ii) Up trains approach the Up Facing Points of the station on the straight on an ascending grade of 1 in 127. The grade then changes to 1 in 338 (ascending), after which there is a level stretch, followed by a descending grade of 1 in 801 through the Up Trailing Points. A R. H. curve of 2508 feet nominal radius commences more or less opposite the station building and continues through the Up Trailing Points, this turn out being of contraflexure.

(iii) The main line consists of 90 lbs. R. B. S. rails 39 feet long on CST-9 sleepers with wooden sleepers at joints to density N+3, and is stone ballasted. The loop line is laid with 76 lbs. B. H. rails 30 feet long on C. I. pot sleepers to density N+2, the ballast consisting of a mixture of mooram and stone. The points at either end are of 90 lbs. R.B.S. section and 1 in 12 angle.

(iv) The Divisional Headquarters is located at Olavakkot.

(v) The kilometrage, reckoned from Madras Central, of the various stations mentioned in the report, is as detailed below :—

	Kms.
Olavakkot	534.47
Shoranur	578.67
Karakad	584.12
Pattambi	590.05
Pallippuram	599.22
Calicut	664.60
Mangalore	885.24

12. Permissible Speeds

The maximum permissible speed on the section is 90 Km. p. h., though the speed through stations is restricted to 50 Km. p. h. on account of Standard I Signalling. The speed over the loop line is restricted to 15 Km. p. h. There were no other permanent or temporary restrictions in force between Calicut and Pattambi at the time.

IV. SUMMARY OF EVIDENCE

13. Driver of No. 28 "Express" Shri S. Palaniappan said that the engine was running normally from Mangalore up to the site of the accident except for the trailing boxes which were knocking--but this was not alarming. Approaching Pattambi he saw that the Loop Home Signal and Loop Starter Signal were

'OFF' for his train. He picked up the token in front of the station building, and, while checking the same, felt an unusual pull from the rear, so immediately stopped the train.

While passing over the portion where the derailment occurred he felt nothing unusual—the speed at the time being about 15 Km. p. h.

He was quite definite that the engine had not derailed at any time.

14. **First Fireman of No. 28 "Express" Shri P. Nayadi** confirmed that between Mangalore and Pattambi the engine was running normally. None of the boxes were running hot, and he did not hear knocking from any of them. Approaching Pattambi he saw that the Loop Signals were "OFF" for the train. The train entered the loop at a slow speed, and, after the engine had passed the trailing points, there was a pull to the rear, and the Driver stopped the train.

The engine did not derail at any time, and while passing over the loop he felt nothing unusual.

15. **Second Fireman of No. 28 "Express" Shri T. Velayudhan** said that running was normal between Mangalore and Pattambi, and he felt nothing unusual when the engine passed over the loop line at Pattambi just prior to the accident. After the engine had passed the trailing points he felt a jerk, and the Driver stopped the train. The engine did not derail.

16. **Brakesman of No. 28 "Express" Shri C. Kunhiraman** said that he was travelling in the leading TLR No. 4774. While passing through Pattambi on the loop he did not notice anything unusual. After passing the station the train stopped, and, getting down, he saw that some coaches had derailed.

None of the parcels in the brakevan fell down or were damaged, and he was positive that the coach in which he was travelling did not derail.

17. **Travelling Ticket Examiner Shri R. Magudapathy** said that he was travelling in Coach No. 5328, and all the way from Mangalore up to the time of the accident running was normal. Passing through Pattambi at slow speed he suddenly heard an unusual loud sound from 2 or 3 coaches to the rear, and simultaneously there was severe braking action and the train stopped. He did not experience anything to indicate that the coach in which he was travelling derailed, and nobody in his coach was injured—according to the inquiries made by him.

18. **Corridor Coach Attendant Shri K. Kandan** said that he was in Coach No. WFC 5898 at the time. Running from Mangalore was normal, but, when passing through the loop at Pattambi, there were a number of jerks—as if the coach had derailed—after which there was a loud noise to the rear and the train stopped.

Getting down after the accident, however he saw that the coach in which he was travelling was on the rails.

19. **Travelling Ticket Examiner Shri G. S. Lakshminarayanan** said that he was in Coach No. 5485, and all the way from Mangalore till the time of the accident the running was normal. He was sitting in the rear of the coach while the train passed through Pattambi, and suddenly heard an unusual loud sound from the front. The coach began jolting, and shortly after it stopped.

20. **Travelling Ticket Examiner Shri P. Balan** said that he was in Coach No. 5456 at the time. Running was normal from Mangalore, but while passing through Pattambi station at a fairly slow speed, he heard a loud crushing sound from the front, and within a second or two the coach in which he was travelling started jolting very badly and then stopped.

21. **Guard of No. 28 "Express" Shri S. R. Gopalakrishnan** said that he was in the rearmost TLR at the time and, while the train was passing over the loop line at Pattambi station at a speed of about 15 Km. p.h., it suddenly stopped with a jerk at 03-15 hours.

Getting down from the train he saw that the 6th, 7th and 8th coaches had derailed. The right leading buffer of Coach No. 5898 had also dropped off and was lying touching the main line.

22. **Leverman Shri M. K. Chami**, who was working as Cabinman in 'B' Cabin at the time, said that since the Up Main Line Home Signal could not be cleared No. 28 "Express" was received on the loop line.

The train passed his cabin slowly, and, after it had passed, 'A' Cabin informed him over the telephone that it had derailed.

He did not hear anything unusual at the time.

23. **Assistant Station Master, Pattambi Shri A. M. N. Bhattathiripad** said that since the Up Main Home Signal had failed No. 28 "Express" was passed through on the loop. While the train was passing through he heard some unusual sounds, and the train stopped suddenly after the engine and the first 3 or 4 coaches had passed over the trailing turn out.

24. **Pointsman Shri K. Velayudhan Nair**, who was working as Cabinman in 'A' Cabin at Pattambi at the time, said that after the engine and the first 3 coaches approximately of No. 28 "Express" had passed his cabin he heard an unusual sound from the Mangalore side, and the train stopped. When he heard the unusual sound he looked back, and it appeared to him as if some of the coaches after the 3rd coach were oscillating.

25. **Train Examiner, Shoranur Shri A. Ramanathan** said that he arrived at the site of the accident at 04-55 hours and noted the following :—

- (a) The engine and the first 5 coaches were on the track, the 5th coach having just passed Kilo-metre Post 590. The wheels of the engine had no marks, but all the wheel flanges and treads of the first 5 coaches had ballast marks, indicating the possibility that these coaches might have also derailed though they were on the track at the time. The right leading buffer of the 5th coach had fallen off, and was lying to the rear near the 6th coach. The corresponding right trailing buffer of the 4th coach had rubbing marks but was not bent nor damaged in any way.
- (b) The 5th coach was damaged and had deficiencies as noted below :—
 - (i) The leading bogie's right trailing bolster suspension outside link was missing—this had dropped off and was found.
 - (ii) The leading bogie's right bolster bottom spring plank and shock absorber were slightly damaged.
 - (iii) The leading and trailing foot boards and brackets were damaged to the right.
 - (iv) Both the equalising stays of the leading bogie were damaged.
 - (v) The right sole plate of the leading bogie was bent.
 - (vi) The left bottom bolster spring plank of the leading bogie was slightly damaged.
 - (vii) The right inside leading bolster suspension link was missing—but was subsequently found.
 - (viii) The trailing bogie's left trailing outside suspension link was missing—but subsequently found.
 - (ix) One equalising stay of the trailing bogie was broken and bent.
 - (x) The left leading inside suspension link stone of the trailing bogie was missing—and not found.
 - (xi) Both the shock absorbers of the trailing bogie were slightly damaged at the bottom.
 - (xii) The right leading buffer bolts were in position with the threads sheared.
- (c) The leading pair of wheels of the leading bogie of the 6th coach had derailed to the left but the trailing pair of wheels of this bogie was on the rails. All the wheels of the trailing bogie of this coach had derailed.
The 6th coach was damaged and had deficiencies as noted below :—
 - (i) The top of the leading bogie's bolster spring plank was damaged.
 - (ii) 6 of the axle guide cap nuts of the leading bogie had sheared, and were missing.
 - (iii) 2 of the axle guide cap nuts of the trailing bogie were deficient.
 - (iv) 2 guide rollers of the trailing bogie were missing.
 - (v) The trailing foot-board on the right was bent.
- (d) All the wheels of the 7th coach had derailed and this coach was damaged and had deficiencies as noted below :—
 - (i) The leading bogie's axle pulley was damaged.
 - (ii) The leading bogie's left shock absorber was deficient—and not found.
 - (iii) The leading bogie's left and right swing links were bent.
 - (iv) 3 guide rollers of the leading bogie were deficient.
 - (v) 1 brake beam and 1 safety bracket of the trailing bogie were bent.
 - (vi) The right shock absorber bolt of the trailing bogie was deficient.
- (e) Only the leading bogie of the 8th coach had derailed, the rear bogie being on the track. This coach also was damaged and had deficiencies as noted below :—
 - (i) The right equalising stay of the leading bogie was bent.
 - (ii) The left suspension link of the leading bogie was missing—but subsequently found.
 - (iii) The brake beam of the leading bogie was bent.
 - (iv) The trailing bogie's brake connecting link pin was disconnected.
- (f) The 9th coach was on the track and not damaged.

- (g) The first 4 coaches sustained no damage, and having carefully checked the under-gear of these coaches, and noting that the brake gear was in tact, the wheel gauge and flange thicknesses were in order, and that there were no deficiencies, he was satisfied about their condition, and certified them fit to proceed on their journey.
- (h) None of the 9 coaches on the train were over due POH.

[This witness was later shown the evidence of the Head Train Examiner, Madras Central, Shri P. Dorai Kanoo, in which the latter recorded the results of his detailed examination of the first 4 coaches at Madras Central. The witness was of the opinion that none of the damages or deficiencies noted would have affected the safety of the coaches when running at high speed upto Madras.]

26. **Head Train Examiner, Madras Central Shri P. Dorai Kanoo** said that he examined 4 coaches at Madras Central on the 25th August. Details of the examination were as noted below :

- (a) **TLR 4774**—The side bearing plate clearances were generally slightly excessive—being up to $3/4$ " against a maximum of $5/16$ ". The wheel flange thicknesses were in order. The table heights were generally in excess of the maximum $3-3/4$ "—being upto $4-5/8$ ". There were no marks indicating damage or derailment.
- (b) **WGT 5244**—Everything was in order, but the axle pulley was damaged, the damage being fresh.
- (c) **GTCW 5328**—The side bearing plate clearances were excessive—being upto $5/8$ " against a maximum of $5/16$ ". The table heights were upto 4"—against a maximum of $3-3/4$ ". On Wheel L-1, there were marks on the periphery including a cut in the wheel flange $1/16$ " deep and 2" long. Similar marks were found on Wheel L-2. On Wheel L-1, the guide roller block was loose. On Wheel L-2, the guide roller outer flange was worn by $1/32$ ". On Wheel L-2, the swing link bolt bracket was deficient. On Wheel L-3, the outside guide roller edges were broken upto $1/4$ " for $1/3$ rd of the diameter. On Wheel L-4, the outer guide roller was broken. On Wheel L-3, there was a grazing mark of $3/8$ " on the periphery of the wheel. On Wheel L-4, the swing link bolt bracket was bent. On Wheels L-3 and R-3 2 swing link bolt brackets were deficient—one in each. On Wheel L-3, there were 3 slight marks on the outside of the chamfer. On Wheel L-4, there were grazing and hit marks on the periphery of the wheel. On Wheels L-4 and R-1, the brake blocks were missing, but the keys and split pins were intact.
- (f) **GST 4454**—On the left leading end there were grazing marks at a height of $10-1/4$ " on the stirrup link stone and pin head, and also on the spring plank as well as the bottom washer of the shock absorber. On Wheel R-1, the outer equalising stay bracket and equalising stay (short) split pin was deficient.

All the marks and damages detailed above were fresh.

27. **Permanent Way Inspector, Shoranur Shri K. N. Balakrishnan** said that he went to the site of the accident along with the Medical Relief Van Special and noted the following :—

- (a) The engine and the first 5 coaches were on the track, but the wheels of the trailing bogie of the 1st coach and all the wheels of the next 4 coaches had ballast marks. He, therefore, thought that these coaches had derailed and rerailed themselves on the crossing of the Down Facing Points whose vee-rail was bent.
- (b) Coach No. 5485 had derailed of all wheels except the trailing wheels of the front bogie.
- (c) Coach No. 5456 had derailed of all its wheels.
- (d) Regarding Coach No. 1225 the front bogie had derailed, but the rear bogie was on the rails.
- (e) The 9th coach was on the track.
- (f) One rail to the right had broken into 7 pieces, and a piece of the rail head measuring about 2" was missing and could not be found. At the time only one end of this rail was visible and the rest was embedded in the soil. No fish plates or fish bolts were broken, except the fish plate at the vee of the crossing which was crushed.
- (g) The track on the loop line consisted of 76 lbs. B. H. rails on pot sleepers to density N+2, and, at the time, the track was not water logged in any way.
- (h) Altogether about 160 feet of permanent way (plain track) were damaged, plus the crossing of the Down Facing Points.

During the 4 years that he had been in charge of the section there had been no cases of fracture of rails on loop lines at stations.

28. Assistant Engineer, Shoranur Shri H. N. Ramanathan said that he went to the site of the accident with the Medical Relief Van Special and found the engine and the first 5 coaches on the rails. The 6th coach had derailed—except for the trailing pair of wheels of the leading bogie—the 7th coach had completely derailed, and the leading bogie of the 8th coach had derailed. The wheels of the 2nd, 3rd and 4th coaches had ballast marks. The splice rail of the crossing of the Down Facing Points was bent, and the distance block damaged. The distance block of the check rail opposite the crossing was also broken and the check rail bent inwards. A rail of 76 lbs. B. H. section was broken into 7 pieces, and, when weighed, the loss of weight was seen to be 10%.

There were no signs of wheels having dropped inside the track which would have occurred had either the gauge spread or wheels shifted inwards on their axles. There were also no signs of mounting the rails.

V. OBSERVATIONS AND TESTS

29. The Track

(i) This was inspected on the morning of the 25th August after restoration work had been completed. The unaffected portion of the loop in rear of the derailment consisted of 76 lbs. B. H. rails 30 feet long laid on C. I. pot sleepers to density N+2, the ballast consisting of a mixture of mooram and stone. The track was generally in a satisfactory condition, there was no water logging, and the gauge, curvature and cross levels for a length of 165 feet in rear of the damaged portion were generally in order. The super-elevation varied from 2-1/2" to 3"—being generally 2-3/4". The joints were not hogged.

(ii) The 76 lbs. B. H. rail, which had broken into 7 pieces, was carefully examined. The fractures appeared fresh, and the broken pieces of rail were straight, and not twisted or bent in any way. A piece of rail head measuring about 2", however, could not be found. At my request the broken pieces of this rail were sent to the Chemist and Metallurgist/Southern Railway for investigation. An extract from his report is reproduced as Annexure-I, from which it will be seen that as far as the rail's chemical composition is concerned, the sulphur and phosphorus contents are extremely high, rendering the material brittle. Subsequently, further tests were conducted by the Chemist and Metallurgist which revealed that the :

- (a) Tensile strength is 49.12 tons per sq. in. ;
- (b) Yield strength is 38.73 tons per sq. in. ;
- (c) Elongation is 19.53 %.
- (d) Izod test :--- 3.1 ft. lbs.

30. The Coaches**

The 5th, 6th, 7th and 8th coaches were examined over the Pit Line at Shoranur on the afternoon of the 25th August. The damages and deficiencies were as detailed in Para 25 above. In addition, the wheel gauge and flange thicknesses were checked, the results being as detailed below :—

- (a) **5th Coach No. 5898**—The wheel gauge and flange thicknesses were in order, except for the flange of the left leading wheel of the rear bogie which was sharp.
- (b) **6th Coach No. 5485**—The wheel gauge and flange thicknesses of all the wheels were in order.
- (c) **7th Coach No. 5456**—The flange thicknesses were in order. The wheel gauge varied beyond the permissible tolerance in the case of the trailing bogie. It also appeared that the axles of the trailing bogie were not true since the wheel gauge varied considerably when measured at different points on the periphery of the wheels.
- (d) **The leading bogie of the 8th Coach No. 1225**—The flange thicknesses were in order, but the wheel gauge of the trailing axle was slack up to 4 mm.

**The Chemist and Metallurgist concluded that the rail failure should be classified under the U.I.C. Code OFD 200.

VI. DISCUSSION

31. Time of the Accident

It is accepted that the derailment occurred at 03-15 hours—as stated by the Guard and Driver of the train, and the Assistant Station Master.

32. Speed of the Train

The train was passing over the loop line at the time, and the evidence was to the effect that it was moving slowly. The Driver and the Guard stated that the speed of the train was about 15 Km. p.h., and the speed

chart extracted from the engine after the accident showed that it was moving at approximately 20 Km. p.h. at the time.

Since the V. D. O. Speed Recorder does not record slow speeds very accurately, it is accepted that the speed at the time was about 15 Km. p.h.

33. Course of the derailment

It is clear from the evidence of the engine crew that the engine did not derail.

With regard to the first 4 coaches the evidence is rather conflicting. The Train Examiner, Shoranur said that the wheel flanges and treads of these coaches had ballast marks; the Head Train Examiner, Madras Central said that the 1st coach (No. 4774) had no marks indicating damage or derailment whereas the next 3 coaches (Nos. 5244, 5328 and 4454) had been damaged to some extent—the damage being fresh; the Permanent Way Inspector, Shoranur said that the wheels of the trailing bogie of the 1st coach, and all the wheels of the next 3 coaches had ballast marks; and the Assistant Engineer, Shoranur said that the wheels of the 2nd, 3rd and 4th coaches had ballast marks. The Brakesman, who was in the 1st coach (No. 4774) was positive that the coach did not derail, and, since the Head Train Examiner, Madras Central also found no marks indicating damage or derailment, it is apparent that this coach did not derail. The 2nd, 3rd and 4th coaches, however, apparently did derail—despite the evidence of the Travelling Ticket Examiner Shri R. Magudapathy (*vide* para 17)—and these coaches must have rerailed themselves on the Up Trailing Points.

As for the 5th coach (No. 5898), the evidence of the Corridor Coach Attendant Shri K. Kandan (*vide* para 18) and that of the Train Examiner, Shoranur clearly indicate that the coach derailed, and this must also have rerailed itself on the crossing of the Up Trailing Points.

34. The Engine (No. WP 7153)

The Driver and the Firemen stated that the engine was running normally from Mangalore. Although the first mentioned stated that the trailing boxes were knocking, he added that this was not alarming. The Driver, who had worked this engine the previous day ex. Shoranur to Mangalore when it was hauling No. 1 "Madras-Mangalore Mail" train, recorded that the riding was steady throughout, and although there was a slight knocking of the trailing boxes—which he had recorded in the Engine Repair Book—none of the boxes ran hot.

This engine had only been received at Shoranur on the 4th August after P.O.H. in Perambur Shops, and Schedule III was carried out on the 5th August, after which the engine was booked out for normal running. Subsequent to Schedule III it had done only 5748 Kms. up to the time of the accident.

After the accident it was checked in the Shoranur Loco Shed by the Loco Foreman and found to be in order.

A perusal of the Engine Repair Book revealed nothing noteworthy. The engine, it might be noted, did not derail, nor was there any indication of its having derailed and subsequently rerailing itself.

I am, therefore, satisfied that the condition of the engine did not in any way contribute to this derailment.

35. The Coaches

It is clear that the 1st coach did not derail at all. The 2nd, 3rd and 4th coaches, however, did initially derail—and then apparently rerailed themselves over the crossing of the Up Trailing Points—but these same coaches, it may be noted, were immediately thereafter permitted to proceed at normal speed to Madras. Although, therefore, there were certain deficiencies in these coaches, and the clearances, etc., were all not in perfect condition, it is clear that there was nothing materially wrong with them which could possibly have caused or contributed to this derailment—which, it may be emphasised, occurred at a speed of only about 15 Km.p.h.

Examination of the other coaches also revealed that apart from damages obviously sustained by the derailment, their defects and deficiencies were such as to preclude any contribution to this derailment—particularly as the speed at the time was low. The only point really noteworthy was the absence of the left shock absorber of the leading bogie of the 7th coach, which, it is felt, could possibly have brought about a derailment at high speed—but certainly not at such a low speed as 15-20 Km.p.h. Further, any damage or deficiency in the 7th coach could not have possibly brought about the derailment of as many as 5 coaches ahead of it at such a low speed.

I am, therefore, satisfied that there was nothing wrong with any of the coaches that could have caused or contributed to this derailment.

36. Cause of the Derailment

From the preceding 2 paras it is evident that there was nothing wrong with the engine or the coaches which could have brought about or contributed to this derailment. An examination of the track immediately

in the rear of the derailment also revealed nothing noteworthy—apart from the fact that it was over super-elevated for the slow speeds at which a loop line is negotiated, and which resulted in increased head wear of the inner rails; this in itself, however—the super-elevation was only 2-1/2" to 3"—could not have caused the derailment.

Attention must, therefore, necessarily be focussed on the broken rail at the point of derailment. The metallurgical investigation revealed that the phosphorus and sulphur contents were very high, and the high phosphorus content may be considered to have rendered the material comparatively brittle—despite the fact that the elongation was as high as 19.53%. The rail was also more than 70 years old, and it had lost about 10% in weight—mainly due to excessive head wear. Its original strength had, therefore, been reduced, and it is also possible that a slight flaw might have developed in the missing 2" portion of rail head resulting in its sudden fracture under the moving train.

It can, therefore, only be concluded that the derailment occurred as a result of the fracture of this rail, which, it is considered, should more appropriately be classified under the U.I.C. Code OFO 200.

37. Responsibility for the Derailment

Apart from the 2" piece of rail head which could not be found, the broken rail did not reveal any other service defects which could have attracted the attention of the maintenance staff. Further, the remaining 76 lbs. B. H. rails on this loop were to all outward appearances, in a satisfactory condition—considering the slow speed at which loops are negotiated. The Chief Engineer has also intimated that no instructions had been issued to maintenance staff that rails lighter than 80 lbs. per yard and more than 30 years old should be removed from loops over which B. G. engines with axle loads in excess of 17 tonnes ply; a general directive had been issued to the Divisions in November 1963 regarding loop lines, but subsequently, on grounds of economy, it had been found necessary to restrict the relaying of loops to those cases which were found to be absolutely essential on grounds of safety—and, it may be noted (*vide* para 27), that there had been no cases of rail fracture on loop lines on this section during the last 4 years.

Para 714 of the Indian Railways Way and Works Manual, an extract from which is reproduced in Annexure—II attached, lays down the policy to be adopted for rail renewals in station yards. The policy enunciated, however, is only in respect of rail renewals as and when required, and, since it is further qualified by the phrase "as far as possible", the relaying of loops with rails of the same section as laid between stations cannot be said to be mandatory.

In the circumstances, therefore, it was not incumbent on the Railway Administration to have renewed these 76 lbs. B. H. rails, and, accordingly, neither the Railway Administration nor any individual can be held responsible for this derailment.

38. Retention of Light Section Rails in Running Lines

The possible maximum vertical bending stress induced in such worn 76 lbs. B. H. rails on C. I. pot sleepers by loaded BOX wagons has been calculated—*vide* Annexure—III. While, therefore, it is appreciated that such a theoretical calculation may not necessarily be strictly accurate—in view of the track moduli constants and the modulus of elasticity of this old rail steel not having been ascertained by actual tests—there is no doubt that these rails are highly stressed under present-day loads. Accordingly, apart from these 76 lbs. B. H. rails—which should be removed in any case because of the high sulphur and phosphorus content—it is considered that rails lighter than 80 lbs. per yard and more than 30 years old should not be retained in passenger running lines over which axle loads in excess of 18 tonnes are permitted.

VII. CONCLUSIONS

39. From the evidence available I conclude that the derailment was brought about as a result of a rail fracturing under the running train.

Neither the Railway Administration nor any individual can be held responsible for this derailment.

40. The relief arrangements were satisfactory.

Yours faithfully,

Sd./—(H. S. Hart)
Additional Commissioner of Railway Safety,
Southern Circle, Bangalore-9.

Bangalore-9
8-10-1970.

ANNEXURE—I

Extract from the Metallurgical Report on the broken 76 lbs. B. H. rail

- | | | |
|-----------------------------|---------|--|
| (1) Weight and type of rail | | 76 lbs. B. H. |
| (2) Rolled markings | | BV and Co MRC 76 lbs. B. H. 1898. |
| (3) Year laid in track | | About 70 years back. |
| (4) Date of failure | | 24-8-1970. |
| (5) Location of failure | | At Pattambi station yard. Km. 590/1-2. |

Visual examination : The rail was found broken into seven pieces. A small piece of the head portion between pieces 4 and 5 was found missing. All the fractured faces are completely coarse and crystalline with sheared appearance at places. The following brand marks were observed on the web of the rail "BS 76 lbs. BH rail Rolling date 1898".

Chemical composition : (%) Drillings taken from the standard location on analysis gave the following results :

Carbon	0.47
Manganese	0.74
Phosphorus	0.196
Sulphur	0.098
Silicon	0.09

Brinell hardness test : (3000 Kgs. load/10 mm ball).

B. H. N. 199-200

Sulphur print and macro etching : Sulphur print taken on a transverse slice cut close to one of the fractured faces revealed segregated dots and ingot pattern. The same piece on macro etching, confirmed the presence of segregated spots and ingot pattern.

Micro examination : Revealed fine to medium grains of pearlite in a slightly banded manner with ghost bands at places.

Conclusion : Chemical analysis, of drillings taken from the standard location of the rail showed very high phosphorus and sulphur. Since the rail has been manufactured in the year 1898, it however, could not be compared to any of the standard specifications. Sulphur print and Macro etching of a transverse slice cut close to one of the fractured faces revealed segregated spots and ingot pattern. Micro structure is considered satisfactory for the material used in the manufacture of the rail. The high phosphorus content observed in the material may be considered to have rendered the material comparatively brittle.

The coarse and crystalline nature of all the fractured faces suggests that the rail has broken in service suddenly, which may be due to abnormal stresses imposed on the rail at the time of failure. The failure is classified as OF/D/200.

ANNEXURE—II

Para 714 of the Indian Railways Way & Works Manual

714. RAILS IN STATION YARDS— When rail renewals are required in station yards, rails to the following standards should be adopted as far as possible :—

(a) Running lines—Renewals in main lines and important loops should be carried out with rails of the same section as laid between stations.

ANNEXURE—III

Possible Maximum Vertical Bending Stress to which the Rail was Subjected

As per the elastic theory for track the maximum vertical bending stress in the rail f_o under a load P is given by :

$$f_o = \frac{26.17 P}{Z} \sqrt{\frac{I}{U}} \quad \text{for single modulus } U \text{ (in fps units)—where } f_o \text{ is in tons/inch}^2, P \text{ in}$$

tons, Z in inch³, I in inch⁴ and U in lb./in/in.

Using two moduli, this equation is modified to the following :

$$f_o = \frac{26.17}{Z} \sqrt[4]{\frac{1}{I} \left[\frac{P_i}{4U_i} + \frac{P_e}{4U_e} \right]} \quad (\text{in fps units})$$

Where P_i is equal to the initial modulus load in tons and P_e is equal to the elastic range modulus load in tons ($P - P_i$).

I.

The moment of inertia of the unworn 76 lbs. B. H. rail is 24.57 inch⁴. The loss of weight was about 10%, and most of this loss was in the head. The moment of inertia of the worn rail has been calculated to be 19.97 inch⁴, i.e. I may be taken as 19.97 inch⁴.

Z.

The section modulus of the unworn 76 lbs. B. H. rail is 8.62 inch³, but, due to the loss in weight, the least section modulus of the worn rail has been calculated to be 6.84 inch³, i.e. Z may be taken as 6.84 inch³.

U_i.

From Civil Engineering Report No. C-71, U_i for metal sleepers track may be taken as 1070 lbs./in./in. However, although from this report it is evident that the effect of the rail section on the track modulus is not appreciable, from Civil Engineering Report No. C-54 it is seen that representative values of U_i should be reduced by 25% to 50% during the monsoons. Bearing in mind, therefore, that the value given in Civil Engineering Report No. C-71 is for main line track, whereas the track under consideration is a loop line and the monsoon period was on, a figure of 650 lbs./in./in. may be taken for U_i .

U_e.

From Civil Engineering Report No. C-71 U_e for metal sleepers track may be taken as 4240 lbs./in./in. However, although from this report it is evident that the effect of the rail section on the track modulus is not appreciable, from Civil Engineering Report No. C-54 it is seen that representative values of U_e should be reduced by 25% to 50% during the monsoons. Bearing in mind, therefore, that the value given in Civil Engineering Report No. C-71 is for main line track, whereas the track under consideration is a loop line and the monsoon period was on, U_e may be taken as 2600 lbs./in./in.

P.

BOX wagons are permitted an overload of 2 tons. From Civil Engineering Report No. C-48 it is seen that the wheel loads of loaded BOX wagons at speeds from 5 to 40 Km. p.h. vary from 9.10 tons to 13.05 tons. For calculating the maximum rail stress, therefore, P may be assumed as 13.00 tons—which may be taken to include the speed effect and the extra load borne by this inner rail because of the track being over-canted.

P_i.

From Civil Engineering Report No. C-67 it is seen that the initial load may be taken to vary between 2 tonnes and 4 tonnes, and the latter is recommended for adoption to be on the safe side. For the purpose of this calculation, therefore, P_i may be taken as 3.5 tons.

P_e.

Since P is taken as 13.0 tons and P_i as 3.5 tons, P_e is taken as 9.5 tons.

Interference Effect

From Civil Engineering Report No. C-67 it is seen that the allowance for relief of stress can be ignored due to variation in the track modulus from point to point in running lines.

Inserting the above constants in the formula, therefore, we get

$$f_o = \frac{26.17}{6.84} \sqrt[4]{19.97 \left[\frac{3.5}{650} + \frac{9.5}{2600} \right]} = 16.3 \text{ tons/in}^3.$$

From Civil Engineering Report No. C-62 it is seen that stresses as high as 22% above the theoretical stresses were observed between sleepers on steel sleepers track to density N+3 :

In the circumstances, therefore, there is the possibility that this rail has been repeatedly subjected to vertical bending stresses as high as 16 tons/in³.

* * * * *

Recommendations/Incidental Observations and recommendations made by the Commission of Railway Safety in connection with the Derailment of No. 28 Up "West Coast Express" train at Pattambi Station, Southern Railway, at 03.15 hours on 24th August, 1970.

1. Rails lighter than 80 lbs. per yard and more than 30 years old should be removed from passenger running lines over which axle loads in excess of 18 tonnes are permitted.

2. From an examination of the 7th coach (No. 5456) it was obvious that the left shock absorber of the leading bogie had been missing for a considerable length of time. The Train Examiner, Mangalore, Shri B. Abdul Razak who examined the rake on the Pit Line at Mangalore on the afternoon of the 23rd August stated that this coach had previously arrived at Mangalore with the shock absorber missing, but

this had been replaced, and when he completed his examination of the rake that evening, all the shock absorbers of this coach were in position. The platform Train Examiner, Mangalore, Shri M. Unnikrishnan stated that when the train left Mangalore, Coach No. 5456 had all its shock absorbers intact. As mentioned above, however, it was quite evident, when this coach was examined by me on the 25th August, at Shoranur, that the shock absorber had been missing for quite some time. The Railway Administration should, therefore, take necessary action against the two Train Examiners in this regard, and tighten up the train examination of important Mails and Expresses.

3. The wheel gauge of coach Nos. 5456 and 1225 varied beyond the tolerance permitted.

4. Regrading of Pattambi station yard to eliminate the present grade infringements was sanctioned in March 1969, and it is unfortunate that this work has not yet been completed. It should be completed without delay, and meanwhile, the Divisional Superintendent, Olavakkot was advised to impose a speed restriction of 15 Km.p.h. over the Down Facing Points in view of the change of grade near the crossing.

Railway Board's remarks on the above noted Recommendations, etc.

1. The Southern Railway is being asked to expedite the renewal of loop lines having rails older than 30 years and lighter than 80 lbs. with rails of poundage of 90 lbs. or higher on passenger running lines over which axle loads of 18 tonnes and above are permitted.

2. Suitable action has been taken by the Railway in this regard.

3. The matter in regard to variation in the wheel gauge of coaches No. 5456 and 1225 beyond the permissible limit is being referred to the Railway and the CRS would be advised further in the matter.

4. In view of the action taken by the Railway no further action is required.



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